Current Density Distribution for a Full Scale Industrial Alluminization Process

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Abstract

It is well know that the direct electrodeposition of very electropositive metals such as alluminium, tin, tantalium or magnesium from aqueous solutions is not possible due to the hydrogen evolution.[1]This drawback can be overcome by using non-protic solvents characterized by large electrochemical window, such as Ionic Liquids. However, the use of such media constitute a challenging quest for galvanic industry since the physical properties of such media; i.e. viscosity, conductivity etc… strongly differ from aqueous solutions.
The main objective of this work is to formalize a complete computational model suitable for the description of the electrodeposition process, in the sense that a time-dependant model of the continuous domains and variables playing an active role in the electrochemical process need to be defined. A common approach to these kind of simulations is the Finite Elements Analysis (FEA)[2,3,4] which is a strategy to solve the governing partial differential equations by means of a suitable discretization.
Respect to the previous approaches, in this communication the electrochemical and chemical kinetics as well as the transport phenomena, were modelled at very high level of theory, taking into account all the parameters affecting the galvanic process, including convection fields. In particular, we considered tertiary current distribution, chemical equilibria and laminar flow, to asses the electrodeposited layer thickness even on sharp edges.
Finally, the computational model have been applied to the classical Rotating Hull Cylinder (RHC) apparatus obtaining reasonable results.

Reference

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